Evidence-Based Diagnosis and Management of Asthma

BUMED Asthma Action Team

2006

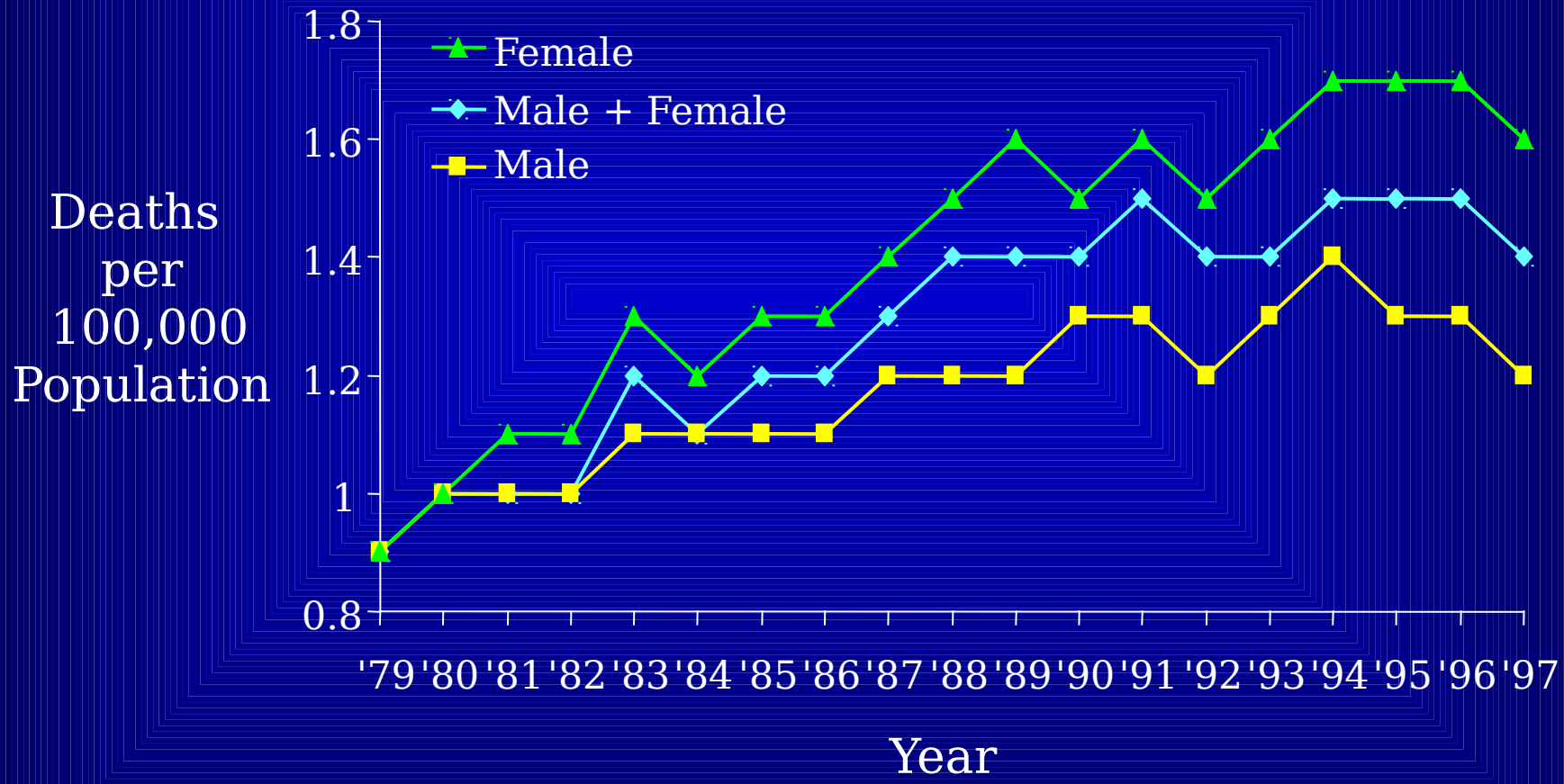
Burden of Disease
General

- Over 300 million asthmatics worldwide[1]
- 10.9% of US population has had diagnosis of asthma sometime during their lifetime[1]
  - 8.6 million were under 18 years of age[2]
- 10.6 million individuals experienced an asthmatic episode during the previous 12 months
- Hospitalizations increased 6.7% between 1988 and 1997[2]

1. *Allergy* 2004 Global Burden of Asthma: 59, 469-478
2. National Center for Health Statistics. Raw Data from the National Health Interview Survey, US, 1997-1998. (Analysis by the American Lung Association Best Practices Division, Using SPSS and SUDAAN software)

Burden of Disease

Death Rate, 1979 to 1997



National Center for Health Statistics. Raw Data from the National Health Interview Survey, US, 1997-1998. (Analysis by the American Lung Association Best Practices Division, Using SPSS and SUDAAN software)

Asthma Definition

1. Inflammatory airways disorder involving mast cells, eosinophils, neutrophils, epithelial cells, macrophages and T cells.
2. This inflammation leads to clinical signs and symptoms of episodic bronchospasm (wheezing, breathlessness, chest tightness and/or cough).
3. Episodes are usually associated with reversible airflow obstruction.
4. Specific airway triggers (such as allergens) incite local inflammation.

Clinical Presentation

- May present as any combination of the following symptoms: episodic wheezing, shortness of breath, or coughing paroxysms
- Patients will sometimes relate a history of frequent “bronchitis” or “reactive airway disease”.
- Often related to specific triggers (cold air, exercise,viral upper respiratory tract infections)
- Often have a personal or family history of atopic disorders (allergic rhinitis, asthma,eczema)

Diagnosing Asthma

- Asthma is, ultimately, a clinical diagnosis.
  - Historical and objective data must be combined to arrive at the diagnosis.
- History
  - Cough, recurrent wheeze, SOB.
    - Note: Many patients may not note wheezing. Cough may be the primary presentation.
  - Symptoms worsen with triggers such as allergen exposure, exercise, pollutants.
  - Symptoms occur or worsen at night, resulting in awakening.

Diagnosing Asthma

- Physical exam
  - wheezing is not always asthma
  - asthma patients do not always wheeze, even during an exacerbation
  - Improvement in the physical exam usually noted after bronchodilator treatment

Diagnosis

- Objective lung studies: In patients ≥ 6 years old, spirometry is used to:
  - Document airflow changes consistent with an obstructive lung disease such as asthma
  - Document clinically suspected reversible* airways obstruction in patients.

*Reversible means that a bronchodilator such as albuterol decreases or “reverses” the airflow obstruction.

Diagnosis

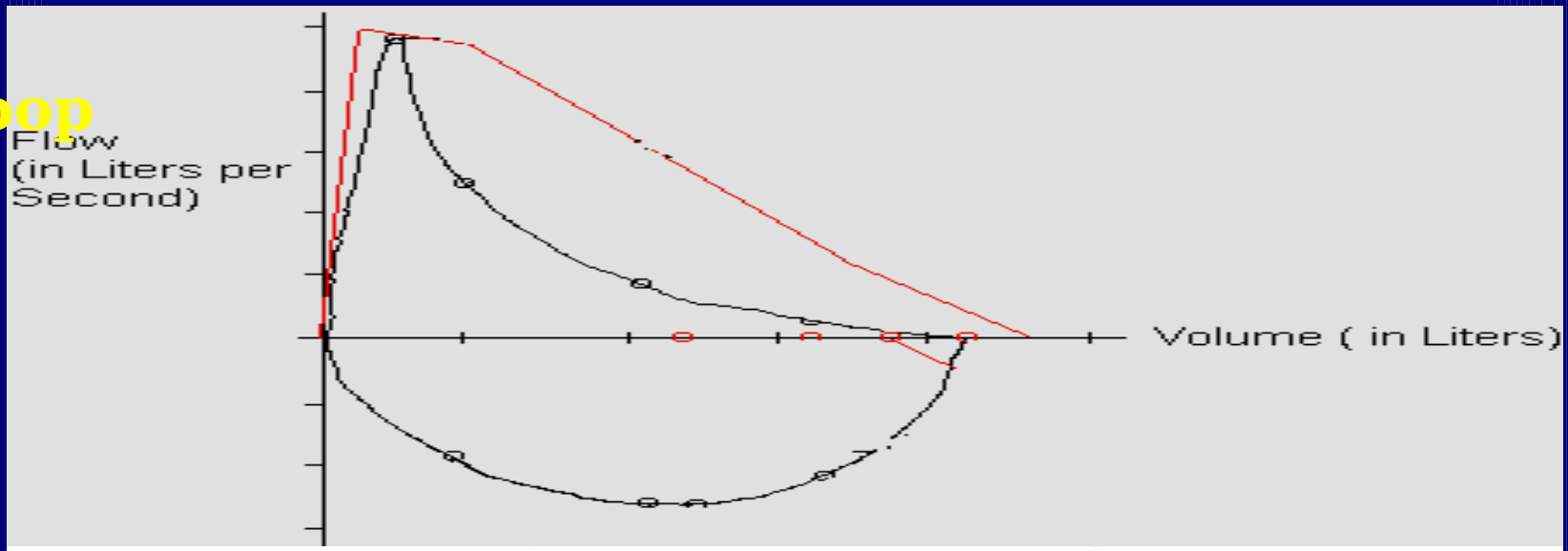
- Documenting reversible airflow obstruction is the most accurate method to diagnose asthma
  - Since asthma is an episodic disease, the lack of reversibility during a healthy period does not rule out asthma
- There are 3 ways to document reversible obstruction.
  - (1) Spirometry; pre- and post- inhaled bronchodilator therapy (eg, albuterol)
  - (2) Spirometry before and after a course of systemic or inhaled steroids.
  - (3) Bronchoprovocation studies

Spirometry Diagnosis

- Classically, see a low FEV_1 (amount of air expired in one second with maximal effort) with a decreased FEV_1 / FVC ratio (FVC is a rough measure of lung capacity) in an asthmatic with active airflow limitation.
- To help confirm asthma, after a bronchodilator or a course of steroids, expect to see:
  - Increase in FVC, FEV_1, or FEV_1/FVC ratio of 12% from baseline; or an increase in FEF 25-75 of 30% from baseline
  - In adults, an absolute increase of 200ml in FVC and FEV1 should also be seen

  Failure to see 12% increase or greater does <u>not</u> mean asthma is excluded.

Normal (red) vs. Asthma (black) Flow Volume Loop



Spirometry		Pre-Drug* Predicted	Actual	%Pred
FVC	(L)	4.01	2.95	74
FEV1	(L)	3.18	1.66	52
FEV.5	(L)		1.13	
FEV1/FVC	(%)	80	56	70
FEF25-75%	(L/S)	3.20	0.80	25
FEFmax	(L/S)	8.14	4.28	53
MET	(SEC)		1.85	
FIV.5	(L)		2.13	
FEF50%	(L/S)		0.95	
FIF50%	(L/S)		4.83	
FEF50/FIF50	(%)		20	

Bronchoprovocation

- Bronchoprovocation studies include cold air challenge, histamine challenge, exercise challenge, and methacholine challenge.
- All of these studies attempt to demonstrate the airway hyperresponsiveness seen in asthma.
- Useful in individuals where the diagnosis of asthma is uncertain (ie: history supports but PFT's are inconclusive).
- Normally performed by an asthma specialist

Precipitating / Sustaining Factors for Asthma

- Allergen exposure
- Allergic Rhinitis
- Exercise
- Viral URI’s
- Rhinosinusitis
- GERD
- Cigarette smoke
- Environmental exposures (eg, pollution, fumes)

Viral Respiratory Infections

- The vast majority (~80%) of acute asthma exacerbations are secondary to viruses
- Most common agent is rhinovirus
- Mechanism is poorly understood
- Most plausible is that existing airway inflammation is up-regulated
- Frequent hand washing and routine influenza vaccination can prevent viral-induced asthma exacerbations

Allergen Exposure/Allergic Rhinitis

- Estimated that 50% or so of asthmatics are atopic.
- In these individuals, allergens are believed to be a major driving factor in chronic inflammation.
- Most significant indoor allergens are dust mite, cat and cockroach.
- Outdoor allergens can also prompt airway inflammation.
- Allergy skin testing or RAST can help identify which allergens are important in individual patients
  - Allergen avoidance may result in disease improvement.
- Control of the atopic response with long acting antihistamines, inhaled nasal steroids or leukotriene inhibitors can help decrease asthma symptoms that are allergen related

Exercise-Induced Bronchospasm

- Probably a subset of asthma, rather than a distinct clinical entity.
- Classically, see worst symptoms and airway obstruction 5 to 10 minutes after exercise.
- Those with symptoms exclusively during exercise are probably mild asthmatics who only get symptoms at the extremes of exertion.
  - Possibly due to cool, dry air inspiration that results in drying/irritation of bronchial mucosa.
  - Typically pre-treatment with short acting beta agonist prior to exercise limits the symptoms from exercise induced asthma, as does exercise conditioning.
  - Consider alternative diagnoses such as vocal cord dysfunction especially if symptoms not improved by bronchodilator pre-treatment

Gastroesophageal Reflux (GER) and Asthma

- GER has been proposed by many authors as a chronic and acute driving factor for asthma, likely via a vagal reflex.
- In studies, perfusion of acid into the esophagus leads to an increase in cough response and increased airways hyperresponsiveness.
- Studies show medical treatment with a proton pump inhibitors can improve asthma symptom control, but not objective lung studies (eg. PEF, FEV_1).
  - studies suggest up to 70% improvement in symptoms.
- Fundoplication may provide even better results than medical management.

Rhinosinusitis and Asthma

- NIH (National Institutes of Health) guidelines recognize that chronic rhinosinusitis can contribute to asthmatic inflammation and poor disease control.
  - 50-80% of asthmatics have chronic rhinitis
- By an unknown mechanism (neural?), inflammation of the nose and sinuses appears to drive or worsen asthma in some individuals.
- Curing the sinus/nasal disease often markedly improves the asthma (ie: inhaled nasal corticosteroid, sinus polyp surgery, long term antihistamines) .

Asthma Classification

- NIH guidelines classify asthmatics into 4 groups based on severity
- Classification is important for physician communication and so appropriate therapy can be used based on published guidelines
- NHLBI (National Heart Lung and Blood Institute)/NIH guidelines for the diagnosis and management of asthma available online: www.nhlbi.nih.gov/guidelines/asthma

Classification of Asthma Severity: Clinical Features Before Treatment

CLASSIFICATION OF ASTHMA SEVERITY					
	Days With Symptoms	**Nights With Symptoms**	**FEV1**	**Variability**	**Treatment**
Step 4 *Severe Persistent*	Continuous	Frequent	≤60%	>30%	**High** Dose Steroid Inhaler Long Acting Beta Agonist Quick Relief Inhaler
Step 3 *Moderate Persistent*	Daily	≥5/Month	>60%-<80%	>30%	**Low to Medium** Dose Steroid Inhaler Long Acting Beta Agonist Inhaler Quick Relief Inhaler
Step 2 *Mild Persistent*	3-6/Week	3-4/Month	≥80%	20-30%	**Low** Dose Steroid Inhaler Quick Relief Inhaler
Step 1 *Mild Intermittent*	≤2/Week	≤2/month	≥80%	<20%	Short Acting Beta Agonist Inhaler (Quick Relief)
Footnote:	*The patient's step is determined by the most severe feature.*				

Stepwise Approach to Therapy: Maintaining Control

STEP 4
Multiple long-term-control medications, include oral corticosteroids

STEP 3
≥ 1 Long-term-control medications

STEP 2
1 Long-term-control medication:
anti-inflammatory

STEP 1
Quick-relief medication: PRN

- ↓ Step down if possible
- ↑ Step up if necessary
- Patient education and environmental control at every step
- Recommend referral to specialist at Step 4; consider referral at Step 3

Asthma Therapy

- Goals of asthma therapy-
  - Prevent symptoms that limit activity and/or result in missed school/work days.
  - Avoid hospitalizations/ER visits.
  - Avoid asthma deaths (3,000 - 5,000/year).
  - Prevent “unchecked” inflammation (poorly perceived PFT abnormalities) that may lead to airway remodeling and irreversible damage.

Asthma Therapy

- Obvious triggers of airway inflammation should be treated and/or avoided if possible.
  - Allergen avoidance may be useful adjunct to meds (for identified indoor allergens).
- Treat allergic rhinitis, sinusitis, GER.
- Full physical activity should be encouraged.

Pharmacotherapy (Long-Term Controllers)

- Inhaled steroids*
- Long-acting beta agonists*
- Leukotriene modifying agents
- Theophylline

*If prescribing controller medications via MDI, the patient should use a valved holding chamber (e.g. Aerochamber)

Mild Intermittent

- NIH guidelines state that patients may be treated with prn bronchodilators alone as long as all of the following are true:
  - Symptoms continue to occur two or less times weekly
  - Nighttime symptoms (awakenings) are occurring less than twice monthly
  - Spirometry is normal at baseline (FEV1>80%)
  - Peak flow variability is < 20%

Mild Persistent

- These are patients with symptoms more than twice weekly (but not daily) who have normal baseline spirometry.
- Require anti-inflammatory medication!!!
- The vast majority of experts and clinicians use inhaled steroids as the treatment of choice for first line therapy in persistent asthma.
  - If one is considering not using inhaled steroids as the first line agent, there should be a compelling reason for that decision.

Mild Persistent

- Using leukotriene modifiers (eg, Accolate, Singulair) mono-therapy as a LTC is discouraged.
- Low dose inhaled steroids (e.g., Flovent (fluticasone) 44 mcg/puff, 2 puffs BID) are usually sufficient in this group.
- Patients should be instructed to rinse mouth after use to avoid thrush and dysphonia.
- If not controlled with the above, the patient is most likely a moderate persistent asthmatic.

Moderate Persistent

- These are patients with daily symptoms, or baseline FEV_1 60-80% predicted.
- Three treatment choices
  - Going from low to medium dose steroids (eg, fluticasone 110 mcg/puff, 2 puffs bid)
  - Add a long-acting bronchodilator (eg, salmeterol)
  - Add an anti-leukotriene agent (eg, montelukast)

Moderate Persistent

- Studies suggest that if a patient is not controlled on medium doses of inhaled corticosteroids, then adding Serevent (salmeterol) is the next best option (Busse et al, 1999: Kelsen et al, 1999).
- This is reflected in recently updated NIH guidelines, where the addition of a long-acting B-agonist is recommended prior to using high dose inhaled steroids or leukotriene receptor antagonists.

Long-acting Beta$_2$-Agonists (salmeterol)

- If needed, these agents should only be used in conjunction with an inhaled corticosteroid (they act synergistically).
- Therapy with salmeterol alone may just be bronchodilating without any effect on the underlying inflammation.
- This can result in undesirable clinical outcomes so this agent should NEVER be used alone for asthma.
- Device is a dry powder inhaler (e.g. Serevent or Advair), which is breath-actuated, requiring no timing or sophisticated technique.
- Recent studies have called into question the long-term safety of salmeterol. Consideration for its use should be limited to those patients uncontrolled on inhaled steroids alone.

Severe Persistent

- These are patients with continual symptoms, baseline FEV_1 under 60%, frequent nighttime awakenings, multiple hospitalizations and/or intubations
- Need high dose inhaled steroid, salmeterol, and possibly montelukast as well.
- Theophylline, and finally oral steroid may be required to fully control such patients.
- A detailed investigation for causes of difficult to treat asthma should be undertaken by a specialist.

Monitoring Asthma Therapy

- Patient self-reporting of asthma symptoms is variably reliable in assessing control.
- Important symptoms:
  - Exercise tolerance
  - Nighttime awakenings
  - Prn albuterol use
  - Missed school/work days
- NIH guidelines suggest that objective monitoring (periodic peak flow and/or spirometry) should be performed at regular intervals.
- This data should be combined with patient symptoms to direct therapy.

Monitoring Asthma

- Spirometry should be repeated at least every 1 to 2 years to assess the maintenance of airway function (NIH guidelines).
- Peak flow meter use is recommended for persistent asthmatics.
- Patients should be given instructions on how to proceed depending on peak flow results
  - (Asthma Action Plan)
- Written asthma action plans specifically have been shown to improve outcomes.

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Important Peak Flow Numbers
- Personal Best (PB) ▪ 80% PB ▪ 50% PB

When to Monitor Peak Flows (PF)
- In the morning, before taking medications
- Late afternoon (3-5 PM)
- Before and 5-15 minutes after Albuterol treatments
- With increased respiratory symptoms

PEAK FLOW AND SYMPTOM BASED HOME ASTHMA ACTION PLAN

The Earlier an Asthma Flare-up is Recognized and Treated the More Successful The Action Plan!

GREEN ZONE (GO!): "Well"	YELLOW ZONE (CAUTION!): "Mild-Moderate Flare"	RED ZONE (DANGER!): "Severe Flare"
➢ Peak Flow between ___ to ____ (80-100% PB) ➢ Able to do normal activity ➢ No symptoms of asthma episodes ➢ Usual medications control asthma	➢ Peak Flow between ___ to____ (50-80% PB) ➢ Increased asthma symptoms ➢ (chest tightness, wheeze, cough) ➢ Waking at night due to asthma ➢ Early signs of cold (runny nose, sore throat, fever)	➢ Peak Flow less than ____ (<50% PB) ➢ Very short of breath ➢ Symptoms for more than 24 hours ➢ Usual activity severely limited ➢ Poor response to YELLOW ZONE ACTION
ACTION ➢ Continue daily asthma control medications and monitoring **My Daily Asthma Control Medicines:** 1)_____ 2)_____ 3)_____	**ACTION** ➢ Continue daily asthma control medications and monitoring PLUS RESCUE ➢ RESCUE =_____ puffs Albuterol MDI and recheck Peak Flow in 5-10 minutes ➢ REPEAT Albuterol treatments up to 3 times then ➢ FOLLOW INSTRUCTIONS FOR RESPONSE BELOW:	**ACTION** ➢ Continue daily asthma control medications and monitoring PLUS RESCUE ➢ RESCUE =_____ puffs Albuterol MDI and recheck Peak Flow in 5-10 minutes ➢ REPEAT Albuterol treatments up to 3 times then ➢ FOLLOW INSTRUCTIONS FOR RESPONSE BELOW:

GOOD RESPONSE	INCOMPLETE RESPONSE	POOR RESPONSE
➢ PF >80% PB ➢ No wheezing ➢ Response to Albuterol lasts at least four hours. ❑ Continue Albuterol every 4 hours for __days AND: ❑ Increase Flovent® to ___ puffs BID (twice a day) for the next ___ days ❑ Notify your PCM	➢ PF remains 50-80% PB ➢ Persistent symptoms ➢ Albuterol effect lasts < 1-2 hrs. ❑ Continue Albuterol _____ puffs every hour for ____hrs AND: ❑ Prednisone / Prelone _____ (mg) by mouth, Now ❑ Contact Doctor or Clinic within ONE HOUR	➢ PF <50% PB ➢ Marked symptoms ❑ Continue Albuterol _____ puffs every hour for___hours AND: ❑ Prednisone / Prelone___ (mg) by mouth, Now ❑ Contact Doctor or Clinic IMMEDIATELY if no contact Go to the Emergency Room or call 911

Refer to Your Tricare Prime Card for After Hours Access
Naval Medical Center SD
Emergency Room
Phone 619 532 8274

Managing Exacerbations in the Emergency Department

- Supplemental O_2 is recommended.
- Repeated albuterol/atrovent nebulizer treatments are routinely performed, though MDI use with a spacing device is just as effective in most patients.
  - The practice of adding atrovent to albuterol improves outcomes.
- If exacerbation initially seems severe, or the patient is failing to improve after 1 albuterol treatment, systemic steroids are indicated (take several hours to take effect).
- If patient fails to improve (doesn't reach 70% of predicted or best PEF as a general guideline), hospitalization recommended.
- High dose systemic steroids and frequent bronchodilator administration are the usual treatment course, with slow taper of the steroids as an outpatient.

Asthma in Children

BUMED Asthma Action Team

2006

Asthma in Children

- 1.3 million under the age of 5 years
  - 80% of asthma presents before age 5
- Often misdiagnosed/mislabeled
- Under-treated
- Associated with high urgent care usage
- Responsible for many sleepless nights
- Most common cause of school absences
- Common reason for parents to miss work
- An unnecessary reason to limit daily activities
- TREATABLE !!!!!

Asthma Often Begins in Childhood

- Up to 80% of children with asthma develop symptoms before age 5 years
- Factors associated with early onset
  - Allergy
  - Family history of asthma and/or allergy
  - Perinatal exposure to tobacco smoke
  - Viral respiratory infections
  - Smaller airways at birth
  - Male gender
  - Low birth weight

Why Diagnose Asthma ?

- Therapy is effective in both relieving and preventing symptoms.
- Delay in starting anti-inflammatory therapy may reduce achievable improvement in airway caliber (lead to permanent airway remodeling).
- Even mild disease increases risk of severe morbidity and mortality.

How do You Diagnose Asthma in Children ?

- Detailed history focusing on episodic symptom patterns of airflow obstruction
  - Cough (especially nocturnal cough)
  - Wheezing
  - Shortness of breath
  - Dyspnea on exertion (or exercise avoidance)
  - Chest tightness
- Physical exam focusing on upper respiratory tract, chest, skin.

How do You Diagnose Asthma in Children ?

- Airflow limitation is at least partially reversible (if child is capable of performing spirometry/peak flows).
- Alternative diagnoses are excluded.
- In young children clinical judgment and /or response to asthma treatment may help confirm diagnosis.

Diagnostic Pearls

- Resolution of symptoms in young child after 7 days of 2 mg/kg/day of corticosteroid.
- Clinical history of symptom improvement after inhaled B_2-agonist.
- The younger the child, the more aggressively one must rule out “asthma imitators” (see upcoming slide).

When You Hear……Think Asthma!

- Reactive airway disease
- Allergic bronchitis
- Wheezy bronchitis
- Asthmatic bronchitis
- Recurrent pneumonia
- Recurrent bronchiolitis/bronchitis

USE THE “A” WORD!!!!!

What Delays Diagnosis in Younger Children?

- Nonverbal
- Symptom reports by parents may be unreliable
  - Daycare
  - Unobserved play at home
- Symptoms episodic, separated by long quiescent intervals.
- Unable to undergo routine pulmonary function testing.
- Physician may defer labeling the condition until symptoms are frequent and severe.

Consequences of Delayed Diagnosis

- Likely to receive ineffective antibiotics, cough suppressants instead of anti-inflammatories.
- The use of euphemisms confuse parents.
- Children have persistent symptoms, school absence, miss out on physical activities.
- Parental anxiety
- Risk of irreversible airflow obstruction.

When Should Wheezing be Called “Asthma”?

- When wheezing becomes recurrent
- When other wheezing conditions have been excluded
- When a number of know risk factors are present
- When the child responds to anti-asthma therapy

Signs and Symptoms Suggesting an Alternative Diagnosis

- Failure to Thrive
- Cyanosis at feeding
- Vomiting at feeding
- Failure to respond to appropriate treatment
- Recurrent sinopulmonary infections
- Clubbing
- Stridor

Asthma Imitators

- Cystic fibrosis
- Gastroesophageal reflux
- Chronic lung disease of prematurity
- Aerodigestive foreign body
- Congenital airway anomaly
- Immunodeficiency
- Congenital heart disease
- Vocal cord dysfunction

Simple Goals of Treatment

Prevent chronic coughing, wheezing, and asthma exacerbations day and night

No missed school

Maintain normal activity levels

Sleep

Learn

Play

Barriers to Using the Correct Control Medication

- Failure to diagnose asthma
- Failure to assign correct severity category
- Choosing the wrong controller
- Unfamiliar with evidence supporting efficacy of inhaled corticosteroid (ICS)
- Relying on recurrent oral steroid bursts
- No time / educational resources to deploy comprehensive treatment plan
- Side effect concerns
- Delivery issues (not using Aerochamber)

Strategies for an Effective Asthma Action Plan

- Teach all patients / caregivers to
  - Monitor and recognize symptoms of early flare
  - Use objective measures plus symptoms
    - Peak flow
    - Respiratory rate
  - Understand the purpose of each medication
  - Follow written instructions
  - Contact PCP when indicated
- Review Asthma Action Plan in clinic / Mock scenarios
- Offer praise when used properly
- Foster a proactive patient

Caregiver Asthma Education

- Dynamic ongoing process
- Begins at diagnosis and integrated into every step of clinical care
- Team approach
  - PCM / Nurse
  - Respiratory Therapist
  - Health Promotions Coordinator
  - Pharmacists
- Regularly teach and review
  - Basic asthma facts
  - Role of medications
  - Device and monitoring skills
  - Environmental control measures
  - When and how to take rescue actions

Guidelines for Referral to Asthma Specialist

- Life-threatening asthma exacerbation
- Asthma therapy goals not met after 3-6 months of treatment
- Signs and symptoms are atypical
- Other conditions complicate asthma or its diagnosis
- Additional diagnostic testing is indicated
- Severe persistent asthma requiring step 4 care
- Continuous or frequent oral corticosteroids
- Under age 3 and requires step 3 or 4 care

Population Health Navigator: Purpose

To facilitate interdisciplinary evidence based decision-making by efficiently and systematically identifying, tracking, and monitoring asthmatic patients.

Each clinic delivering primary care is encouraged to review PHN asthma data on a routine basis to monitor their effectiveness in reaching BUMED asthma control benchmarks using inhaled corticosteroids for persistent asthmatic control

Asthma Knowledge Quiz

Which of the following is false regarding the use of short-acting inhaled B_2-agonists (albuterol)?

a) Most effective medication for relieving acute bronchospasm
b) Use of more than 1 canister per month indicates inadequate disease control
c) Should be used in a scheduled manner to reduce frequency of attacks
d) Frequent use can lead to decreased #'s of B_2-receptors in the lung

Which of the following statements regarding the use of inhaled corticosteroids is false?

a) Decrease the overall severity of asthma

b) Prevent lower airway scarring

c) Act as a direct bronchodilator

d) Associated with an increase in peak flow over time

A 27 yo male with FEV_1 of 85% predicted uses B_2-agonists daily for symptoms and has no nocturnal symptoms. This patient would be classified as:

a) Mild intermittent

b) Mild persistent

c) Moderate persistent

d) Severe persistent

A 9 yo female with FEV_1 of 80% predicted has symptoms twice a week which requires B_2-agonist and often requires her to stop her activities, and has nocturnal symptoms 3-4 times a month. This patient would be classified as:

a) Mild intermittent

b) Mild persistent

c) Moderate persistent

d) Severe persistent

Which of the following is <u>not</u> a direct cause of airway obstruction in asthma?

a) Eosinophilia
b) Acute bronchospasm
c) Airway edema
d) Chronic mucous plugging
e) Lower airway scarring

For asthma patients without symptoms between attacks, which of the following statements regarding their long-term management is <u>not</u> correct?

a) Generally do not require daily medications

b) Short-acting inhaled B_2-agonists as needed are usually sufficient

c) Using short-acting B_2-agonists more than twice a week suggests they may benefit from long-term control medication

d) They generally do not need to undergo periodic spirometry

Which of the following statements regarding long term control of asthma is false?

a) Due to side effects, inhaled corticosteroids should not be used until a patient has failed other modalities
b) The most effective medications are aimed at decreasing inflammation, rather than achieving bronchodilitation
c) Higher-dose therapy is used initially, then tapered to the lowest effect dose regimen
d) Inhaled corticosteroids can normalize lung function and prevent lower airway scarring

Which of the following data sets is most suggestive of asthma as a primary diagnosis?

	DL_{CO}	FEV_1	FEV_1/ FVC	FEV_1 (Post Albuterol)
a)	50%	35%	50%	37%
b)	80%	85%	85%	91%
c)	50%	55%	100%	55%
d)	105%	70%	78%	85%
e)	70%	70%	78%	85%

Which of the following is not consistent with Mild Persistent Asthma?

a) Daily short-acting inhaled B_2-agonist use

b) Peak expiratory flow variability of 20 -30%

c) Nocturnal symptoms once per week

d) FEV_1 > 80% predicted

For a patient with moderate persistent asthma who is inadequately controlled on daily low dose inhaled corticosteroids, which of the following regimens is not appropriate?

a) Change to medium-high dose ICS
b) Add long-acting inhaled B_2-agonist
c) Add scheduled short-acting inhaled B_2-agonist
d) Add leukotriene modifying agent

Which of the following is most consistent with a diagnosis of asthma?

a) Reduced FEV_1

b) Reduced forced vital capacity (FVC)

c) Reversibility of airflow obstruction

d) Decreased diffusion capacity

e) Increased diffusion capacity

Which of the following is not suggestive of asthma?

a) Wheezing

b) Stridor

c) Cough which is worse at night

d) Recurrent chest tightness